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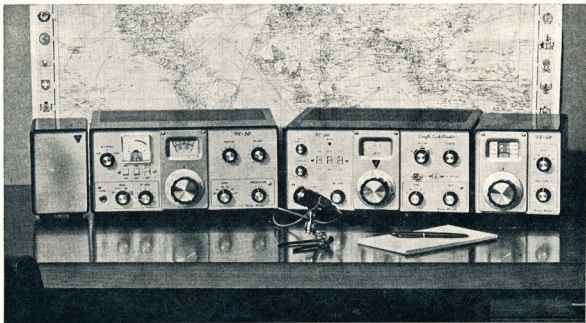
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AN ALL FET 2 METRE CONVERTER

H. L. HEPBURN,* VK3AFQ, and K. C. NISBET,† VK3AKK

THE converter which is the subject of this article is a result of work done to take advantage of advances in semi conductor devices since the 144 Mc. converter described by the authors some twelve months ago in the June 1967 issue of "A.R." Similar circuitry was briefly outlined by one of the writers in a recent issue of the Bulletin of the Mountain and Eastern District Radio Club.

The original 2 metre converter, using bi-polar transistors throughout, worked extremely well and many were built. However, the subsequent availability in Australia of Field Effect Transistors (FETs) led to their use in converters and other equipment. Examples of such use are the series of h.f. converters developed by the Moorabbin Radio Club and the six metre converter described by the VK3 V.h.f. Group. Both of these converters used T.I. 2N3819s as r.f. and mixer stages, but retained the use of bi-polar transistors in the oscillator chain.

Subsequent developmental work showed that performance could be improved by the use of cascaded r.f. stages and the replacement of the bipolar transistors by FETs in the oscillator section.

The recent availability in Australia of the dual gate FET (specifically the 3N140/141 series made by R.C.A. and distributed through A.W.V.) led to further experimentation and the design now offered is the outcome of this work.

The overall effect has been to produce a much simpler unit having a better performance, a wider bandwidth and a significantly lower cost.

As with any converter it is meant to be fed at low impedance into a tuneable "back end" such as the station receiver. The range of output i.f.s available with the present converter is quite wide and falls between 3 Mc. and 30 Mc. with no circuit changes and only minor alterations to the coils in the oscillator section. The circuit and coil details given in this article refer to an output i.f. of 14 Mc.

GENERAL DESCRIPTION

Fig. 1 gives the circuit, from which it can be seen that the r.f. stage is an R.C.A. 3N140, the mixer stage is a 3N141, while Motorola MPF102 single gate FETs are used as oscillator and multiplier. A third MPF102 is used as a source follower output stage to effect the necessary impedance transformation between the mixer drain and the input to the tuneable i.f.

The source follower, besides making this required impedance change, also replaces the more usual tuned circuit in the drain of the mixer and thus, not being frequency conscious, allows a much greater usable bandwidth to be

achieved. In this converter the usable bandwidth is the full 4 Mc. of the 2 metre band.

Input to the converter is via L1, which is tuned by circuit strays to the operating frequency. The antenna lead is tapped down the coil to provide the proper impedance and noise factor matching.

A 1,000 pF. capacitor (C1) is included in the antenna lead to provide d.c. isolation should the converter be used in conjunction with other equipment having a positive ground rail.

The signal is fed to gate 1 of the 3N140 r.f. stage. While the (rather scant) literature on dual gate FETs suggests that forward biasing of the signal gate has some advantages with regard to gain, no significant effect was

Oscillator injection to the mixer is via gate 2 which has d.c. bias applied through R11 and R12, decoupling being provided by C11.

The mixer load is R5 and the mixer drain is coupled directly to the gate of the MPF102 source follower. The source follower load is R6 and output is taken via C7.

In this design an i.f. output frequency of 14.00 Mc. has been adopted and oscillator injection is on the low side, i.e. 130 Mc. This is obtained by using an MPF102 as a crystal oscillator on 32.5 Mc. and a second MPF102 as a quadrupler to 130 Mc.

The crystal oscillator itself calls for some comment in that provision has been made for "pulling" the crystal to an exact frequency. While this may

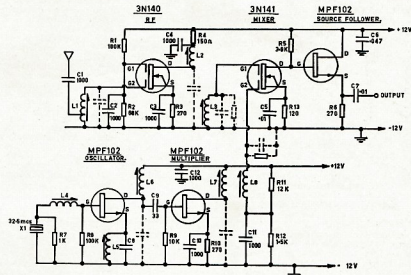
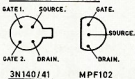


FIG. 1. TWO METRE ALL F.E.T. CONVERTER.

BASE CONNECTIONS.



noticed by so doing and it has been left at d.c. earth. Gate 2, however, is biased for d.c. by R1 and R2 but grounded for r.f. by means of the 1,000 pF. capacitor C2. R3 provides a degree of device protection but r.f. grounding of the source is assured by C3.

The amplified signal then goes through the band pass coupler L2/L3, both coils using circuit strays for resonance. The signal is then applied to gate 1 of the 3N141 mixer. The makers do not recommend the use of d.c. bias on the signal gate in mixer service.

not be strictly necessary in the majority of Amateur applications, the facility is of great importance if the converter were used in conjunction with a fixed channel i.f. For example, a three channel "front end" for the 2 metre f.m. nets and a 10.7 Mc. i.f. channel with a block or crystal filter does need precise adjustment of the first oscillator if each channel is to be lined up "spot on".

A very low resistive load (R7) is placed across the crystal and a coil (L4) used in series with the lead to the oscillator gate. This inductance should have a reactance equal to (but of opposite sign) the parallel capacity of the crystal at the crystal frequency. Adjustment of the core of L4 allows a frequency variation of some 0.25%.

The tuned circuit in the oscillator source (L5, C8) resonates at two-thirds of the crystal frequency while the

* 4 Elizabeth St., East Brighton, Vic., 3187.
† 29 Thames Ave., Springvale, Vic., 3171.

oscillator load (L6) resonates at the crystal frequency.

The band pass coupler in the multiplier drain circuit (L7, L8) is on the required injection frequency and serves to "clean up" the injection waveform by removing harmonics other than that required. This has the effect of eliminating possible images.

The capacitance shown dotted across all the coils except L4 and L5 are not needed for operation on 144-148 Mc. but have been shown to indicate that all that is needed for operation on lower frequencies is the addition of parallel capacity. No change is needed to the signal coils down to 50 Mc. but obviously changes in the crystal, L4, L5 and C8 will be needed for such wide excursions in frequency.

By making changes in all the coil data the converter will work right down to 21 Mc. but, since the gains of the devices rise as frequency decreases, it was found necessary below 80 Mc. to add some resistive damping to L3 and L8.

COIL DATA

Coil	No. of Turns	Spacing	Wire Gauge
L1	8	Over 1/2"	20 s.w.g.
(tap at 2)			
L2	9	Over 1/2"	20 s.w.g.
L3	8	Over 1/2"	20 s.w.g.
L4	15	Close Wound	28 s.w.g.
L5	20	"	28 s.w.g.
L6	25	"	28 s.w.g.
L7	12	"	20 s.w.g.
L8	10	"	20 s.w.g.

Notes—

- All wire is enamelled. Use of the nearest B and S wire is satisfactory.
- All coils are wound on Neosid type 722-1 coil forms and use F29 cores. Bases are not used but screening cases (type 7100) are fitted.

RESULTS

At the time of writing, one 160 Mc., three 144 Mc., one 80 Mc. and one 21 to 30 Mc. converters have been built and tested.

In the case of the 144 Mc. units, all have a bandwidth of 4 Mc. plus or minus 1 db. and the noise figures range between 2 and 4 db. in the "as built" state. Noise figure improvements can be obtained by optimising the antenna coil tap position. Sensitivity is more than adequate and, using a reasonable communications receiver as the tuneable i.f., a signal of 0.1 uV. is quite readable. Since the noise factor of this converter is so low, the noise level in the tuneable receiver can be of significance in determining overall sensitivity.

CONSTRUCTION

The converter is built on a 4 1/2" x 2 1/2" epoxy glass printed circuit board. Components may be put on in any order, but the mounting of the r.f. and mixer FETs calls for some care. While not as sensitive as some MOSFETs, it is still advisable with the 3N140/141s to short all leads together by wrapping them with fine wire (5a. fuse wire is fine) at the case end before soldering them into circuit. Once in place this

wire can be removed. As an added precaution, it is best not to handle the devices by their leads but only by the case.

Mounting screws should be electrically independent of the circuit "wiring" to allow the converter to be used in systems of mixed polarity. This has been done in the board used in this design.

AVAILABILITY

During the development of this converter a considerable amount of interest was shown by local Amateurs, and indeed by non-Amateurs in the flying and gliding fraternity. This article is a direct result of that interest.

In keeping with the trend set by the Moorabbin Club, full or part kits will

be made available. It is anticipated that the cost of the complete kit, including all components, crystal, printed circuit board, diagrams and full instructions will be \$23.50 plus postage. Printed circuit boards will be made available separately at \$2 (plus postage), while the diagrams and instructions will cost \$1 plus postage. For club projects a 10% reduction in cost of complete kits will be available if ordered in lots of 10 or more.

Since, in previous projects of this sort, several enquiries were received for completely made up and operating units, consideration will be given to providing this service if required.

Enquiries should be directed to the Project Officer, 4 Elizabeth St., East Brighton, Vic., 3187.

A Simple and Easy to Build Product Detector

Over the past six months or so, I have been experimenting with product detectors and I think by now that I have made up and tried all of the available types, with somewhat mixed success. Some worked fair, some worked poor, one reasonably good, but all in all, due probably to my ignorance on the subject at the beginning, I never succeeded in finding a circuit which gave me complete satisfaction.

However, in "CQ" for March 1967, page 87, and "73" for May 1967, page 75, there appeared a diode product detector which, by its very simplicity, seemed too good to be true and was dismissed from the experimental and constructional programme until it again appeared in a recent R.S.G.B. Bulletin.

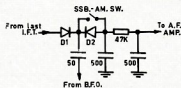


FIG. 1. PRODUCT DETECTOR CIRCUIT.

It was eventually assembled and wired on a piece of wiring board three inches by one and a half inches, in less than an hour and under test proved to be the answer to the product detector experiments.

Containing three condensers, two diodes and one resistor, it worked perfectly at first trial and the switch gives a bonus of a.m. plus s.s.b. reception by shorting out the second diode when needed.

Several types of diodes were mentioned in the articles, but I used a couple of old OA85s, pinched from the grandson's crystal sets, which were not matched in any way, in fact they were both of different makes. The circuit worked perfectly at the first attempt and is still in use in the receiver and can be thoroughly recommended to anybody desiring to use s.s.b. reception with the least trouble and energy.

—VK5PS, W. W. (PanSy) Parsons.

NEW 576 Mc. RECORD

On Saturday, 13th April, the present 576 Mc. record of 145 miles held by VK5ZJL was broken. Contact was established over the 184 mile distance from Port Augusta to Eden Hills, a southern suburb of Adelaide, between Charles VK5KWJ and Rod VK5ZSD (formerly VK5LK and VK5ZDS).

Two metres was used as a link, and contact was made on this band at 1815 mHz. The signals about RS 83 with some QSB. On shifting to 576 Mc. signals were surprisingly stronger & steady SSB both ways. Both stations then stayed on that band until about 1825 C.S.T., signals remaining fairly steady during the QSO.

The equipment used at both ends is as follows:

- (1) Adelaide, VK5ZSD—Tx: QXQ2/20 straight final, output 25w., output 8w. Rx: T1588 (FET) pre-amp, 2 x E28 r.f. amps., 60W. motor to SE700B receiver. Antenna: 4, 15 element Yagi, 30 ft. high.
- (2) Port Augusta, VK5KWJ—Tx: QXQ2/20 tripler, input 25w., output 4w. Receiver: T1588 pre-amp, 7077 r.f. amp., 1N21 mixer, to CR150 receiver. Antenna: 16 element screened beam, 15 ft. high.

The path between the two stations was nowhere near line of sight, as the heights of the Adelaide and Port Augusta stations were 700 ft. and 60 ft. respectively. However, a considerable portion of the distance was over water, and the remainder over fairly flat country. Judicious use of the equipment used is capable of operating over even greater distance beyond 200 miles.

—Reprinted from W.A. V.h.f. Group News Bulletin.

Wireless Institute of Australia Victorian Division

V.h.f. Group Convention

to be held at

BENDIGO

on

SATURDAY and SUNDAY,

12th and 13th OCTOBER, '68

Further particulars from Secretary, V.h.f. Group, P.O. Box 36, East Melbourne, Vic., 3002. Please mark envelopes "Convention".

TRANSISTOR SIDEBAND-C.W.

COL. HARVEY,* VK1AU

HAVING deserted the brass-pounders union many years ago in favour of s.s.b. with vox, I now find that some of the pioneer sidebanders have turned back to c.w., apparently to develop and use automatic keyers.

Although many a cross-mode contact has been enjoyed, the lack of that peculiar satisfaction that comes from skilful c.w. operation had begun to nag.

Granted that c.w. is a slow means of communicating, it still has the virtue that skilled operators can often "communicate" when other modes are out of business (e.g. summer nights 7 Mc. DX). Also, when conditions are good, the skilful c.w. operator can enjoy the challenge of high speed Morse communication, which with auto keyers is somewhat akin to having a "tiger by the tail".

As a prelude to construction and occasional use of an auto keyer which would exploit this aspect of Amateur Radio, an effective means of keying the VK1AU transistor s.s.b. exciter had to be found. Initial experiments were made using carrier obtained by unbalancing the modulator just enough to allow the linear amplifier to draw its rated plate current. Although satisfactory, this method had the disadvantage that the modulator subsequently had to be rebalanced before carrier-free s.s.b. could again be radiated. As many will have noticed, carrier "nulling" is not always a quick adjustment, and even a minor inadequacy in suppression is, for some obscure reason, quickly noted and commented upon.

The results of recent experiments in search of a suitable carrier keying method for my s.s.b. transmitter can be summarised as follows (first the method, then the result):—

(a) Keyed tone oscillator adjacent to microphone.

Broad m.c.w. signal (unless audio drive to balanced modulator removed).

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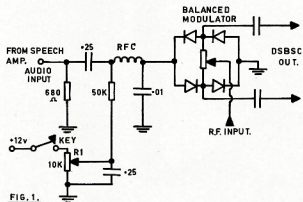


FIG. 1.

"Clipped" Morse, due to effects of acoustics and vox and ant. relays.

Full break-in.

(b) Centre tap keying of linear amplifier.

Excessive clicks locally, despite classic filtering methods.

Extra relay needed.

No break-in.

Mechanical noise.

Strong residual carrier locally.

(c) Emitter bias keying of transistor amplifier stage.

Excessive residual carrier.

Rather hard keying characteristics.

Instability.

(d) Keying 12 volt line to first transistor amp.

Noticeable residual carrier.

Slight clicks, hard to filter.

(e) Keying vox relay tube bias.

Full break-in.

Limited keying speed.

Occasional imperfect Morse unless vox trip and anti-trip gains turned off.

None of these methods seemed good enough to warrant construction of an auto-keyer. Despite the prevalence of "hard" keying characteristics needed for fast keying, the most irritating deficiency was the presence of residual carrier on the transmitting frequency. Although not particularly harmful on DX contacts, it affected the clarity of the signal locally and became irritating to listen to in the monitor.

Keying a mixer or oscillator would obviate this problem, but with the diode mixers in use there seemed initially to be no easy method of keying.

Eventually, however, the penny dropped. It was realised that with the complete transmitter chain "on-the-air", and with carrier balanced out, very little carrier was heard locally (i.e. the residual carrier was about 50 db. down). Yet with full carrier, signals were paralysing. Therefore why

not transmit c.w. by inserting about 50 db. of carrier via the balanced modulator?

An obvious method was to key (by use of a relay) additional resistance of capacity across the previously balanced bridge modulator. A better method was to unbalance the bridge with a suitable keyed d.c. voltage whose amplitude could be adjusted to set the desired amount of carrier insertion, and hence carrier level. The basic schematic is shown in Fig. 1.

On-the-air reports using this method show the result to be the best of all methods tried to date. There is, however, a minor problem—during c.w. operation, the audio input to the balanced modulator should be removed. Although not absolutely essential, it is preferable that the mechanical and other noises which accompany handset Morse not be superimposed on the carrier via the microphone and speech amplifier. The simplest way to avoid this is to forego break-in operation, use a d.p.d.t. switch to isolate the d.c. supply to the microphone amplifier, and at the same time activate the vox relay (so as to initiate receiver muting and antenna change-over).

Since the vox unit in use at VK1AU has the capability to set the receiver mute level anywhere between fully cut-off and not cut-off (by a negative bias on the i.f. strip suppressor grids) monitoring is accomplished simply by adjusting the receiver muting bias level to a value which provides a suitable audio output from the receiver. Where incoming signals are sufficiently strong, it will still be possible to work full break-in. Regrettably, full break-in with weak stations is not possible because the antenna change-over relay remains in the transmit position whenever the vox relay is energised for the transmit mode.

Readers who require full break-in can probably devise a method of controlling the antenna change-over relay in sympathy with keying. A simple but generally effective method is to

(Continued on Page 11)

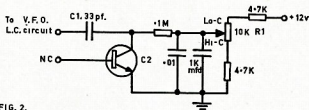


FIG. 2.

Fig. 1 (at left).—No Keying Filter is required, nor need the keying leads be shielded. Values given are not critical. The 10K potentiometer (R1) can be pre-set to the carrier level required for c.w. operation.

Fig. 2 (above).—The voltage variable capacity C2 can be either a diode which exhibits the effect, or as in this case, an NPN audio transistor. The amount of frequency change is determined by the size of the series capacitor C1 and by the voltage change available across R1. The values shown provide about 3 Kc. at 2 Mc. The .01 and 1,000 uF. filter are needed to prevent power supply ripple, etc., from frequency modulating the v.f.o.

"A HANDY D.C. SUPPLY FOR THE BENCH"

Editor "A.R.," Dear Sir,

In the April issue of "A.R." I found the publication of my article on "A Handy D.C. Supply for the Bench." On looking through it, I found that a few errors had been made and list them below.

- (1) Transformer 1 has only five windings on the secondary side. S1a selects the same point for 30v. and 36v.
- (2) The bottom OA210 connected to transformer 2 is shown the wrong way around.
- (3) The reservoir and output filter condensers in the reference supply should be 1,000 uF. 30v. The 100 uF. (.25v.) connected to junction of 2.7K and 1.5K is correct.
- (4) The output filter condenser in the main supply should be 5,000 uF. (35v. min.).
- (5) The shunt resistor for the meter should be 40 milliohms, not 40 megohms as stated.
- (6) Type number of series regulator in reference supply missing (2SO18), also a and b on switch 1 and pointer in meter. Output voltage is 0-36v. (zero to 36). Circuit printed says -36v.

The accompanying two photographs of the unit are explained below.

The front panel shows the meter which is red-lined at 36v. and 2a., the high-low load switch S3, mains fuse holder, mains switch, and 6v. pilot lamp.

Below the load switch and a little to the right is the meter switch, reading volts in the up position and amps. in the down position. This is also the way in which the meter scales are drawn.

Under the meter switch we find the voltage step selector S1, to the right of it is the fine adjust control, which was later fitted with a knob.

The output terminals are below the meter.

The left side of the housing is liberally vented, as is also the back panel and the rear quarter of the top (not shown in photograph).

The rear view shows the series regulator, 2N513B and its heatsink. To the left of it is the pre-regulator, with epoxy resin encased tranny and diodes plus condensers and 330 ohm resistor mounted on a small piece of matrix board.

Looking towards the front, the terminal board of transformer 1 can be seen. To the right of it is the 4,000 uF. reservoir condenser, and the top portion of the main rectifier heatsink.

Transformer 2 is mounted between transformer 1 and the front panel.

Just behind the 4,000 uF. condenser is the 5,000 uF. output filter condenser. The small transistors and associated components are all mounted on two small pieces of matrix board right behind the air vents in the side panel.

All wiring in the unit should be of fairly large cross-section where high currents are being handled, particularly around transformer 1, S1a and main rectifier. 40/0076 is a suitable size. The zero volt and negative 0-36v. line between the 5,000 uF. condenser and the output terminals should also be of heavy gauge.

Due to the "growth" of the supply beyond the originally envisaged size (electronically) space inside the cabinet is now rather limited and I suggest to provide a bit more room around most components than does exist in my unit, in the interests of ease of maintenance and to provide some breathing space for the overload protection circuit which will be provided in the near future.

The ripple voltage on the output is about two to three milliwatts peak to peak, which is sufficiently low for tests on sensitive pre-amps. of many kinds. This figure holds good for loads up to 2 amps.

—Rolf B. Petersen, VK5ZIE.

Adapting the Geloso G209 for S.S.B. Reception

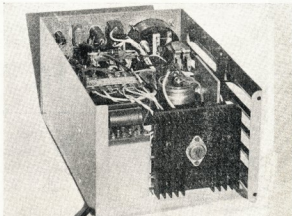
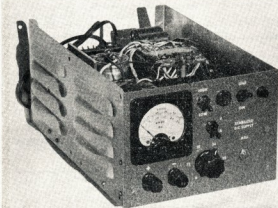
The Geloso G209 Receiver was designed some ten years ago and incorporated many features that were well up to date at the time. These included selection of upper or lower sideband, also a product detector. Why, then, you might ask, do we need to "adapt" the receiver for s.s.b.—after all, it has an s.s.b. position on the front panel (two in fact) and the handbook gives details on how you should tune s.s.b. Here are the reasons:—

It is quite impossible to resolve strong s.s.b. signals with the r.f. gain fully advanced and very difficult with the r.f. gain fully off, due to apparent overload somewhere along the line. Now most of this overload distortion occurs because the Geloso engineers forgot to put bias on the 6BE6 product detector. The remedy—put some in.

Lift the earth connection from the cathode of the 6BE6 (V9, pin 2) and wire in a 500-ohm $\frac{1}{2}$ watt resistor and bypass this with a 25 uF. 6 volt electrolytic. This cleans up all the distortion but now there is too much r.f. input to the 6BE6 from the i.f. strip when the r.f. gain is full up. A 47 pF. ceramic or mica condenser from the input grid (pin 7) of the 6BE6 to earth now enables us to run the r.f. gain full on even with strong signals.

Now we are starting to get somewhere, however there is still one problem left. With the r.f. gain fully up, the a.g.c. action is too fast. To slow the a.g.c. down a bit a 2 uF. 12 volt electrolytic condenser is connected from the a.g.c. line to earth (positive to earth). You might prefer to connect this through a switch to give a choice of fast or slow a.g.c. however the slow acting a.g.c. is still okay for a.m. reception.

This completes the modification, you can now tune s.s.b. with full r.f. gain, slow release a.g.c. and of course the S meter will now give a comparative indication.



S.W.R. INDICATORS—FACT OR FICTION

J. G. REED,* VK2JR

RECALLING the hullabaloo following the publication of my earlier technical article explaining the real reason for generation of sideband transients in overmodulated a.m. transmitters, it is with trepidation that I commit a further incoercible outrage by questioning another cornerstone of Amateur Radio faith.

So-called Standing Wave Indicators and Reflectometers are accepted by the overwhelming majority of Amateur station operators as instruments of precision capable of measuring a somewhat mythical quantity referred to as reflected power in radiating systems and transmission lines. Forward and reflected waves may be factual in a bathtub, but are somewhat of a mathematical fiction. Electrons do not rush madly forth and back at almost the speed of light. Amateur s.w.r. indicators and reflectometers are credited with the power to discriminate against the direction of flow of these fictional travelling waves.

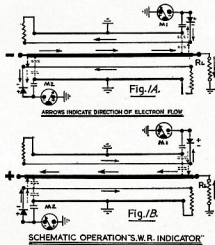
Fig. 1 illustrates the simplified connections for a typical commercially available s.w.r. indicator. The two diode circuits are supposed to measure the magnitude of the alleged forward and reflected waves. Without fear of effective contradiction it is my contention that nothing of the sort occurs.

Current in the central conductor has a magnetic and electrostatic component which induce current flow in the two metering circuits, the diodes of which function on alternate half cycles to provide the d.c. component to the meters. The magnitude of these currents depend on the phased combination of magnetic and electrostatic components. A basic initial adjustment in these instruments is to select a so-called terminating resistance for the diode lines which will cause a voltage drop due to the electrostatic component, equal in magnitude to that due to the magnetic component.

Examine Fig. 1A carefully and note the instantaneous values of electrostatic and magnetic components, both as to magnitude and phase. The lengths of the internal lines are assumed to be very small fractions of a wavelength at the highest measuring frequency. Assume nominal electron current flow on the negative half of a cycle from left to right, and from right to left on the positive half. Corresponding flow of induced current in the metering lines will be in opposite direction. Electron flow in the metering and diode circuits is shown in solid lines for magnetic component and dotted lines for the electrostatic component. Under condition "B" neither meter M1 nor M2 will read. The first meter M1 because magnetic and electrostatic components are in opposition, and meter M2 because both components, although in phase, are in opposition to the diode conductivity. Condition "A", where the

direction of electron flow (nominal) reverses, meter M1 again reads "nil" because of opposition of magnetic and electrostatic components. Meter M2, having both components in phase and in the correct direction of flow for the diode to conduct, will read. Calculation from respective meter readings will now produce the much sought after figure of $s.w.r. = 1$ with zero "reflected" power component.

Should the external load "RL" be varied without corresponding adjustment of the so-called terminating resistors to maintain balance between magnetic and electrostatic components in the metering circuits, both meters will read currents, and depending on the magnitude of the resultant currents, calculation will reveal the disturbing fact that the standing wave ratio is no longer ONE, and in addition the completely non reactive external load resistor has started to "reflect" power.



If the external load is of complex nature containing both resistive and positive or negative reactive component, even though the "Z" or complex impedance may equal numerically the figure for a simple non-reactive resistance, the phase relationship of voltage and current components will permit both meters to read and indicate an increasing so-called "standing wave ratio and reflected power".

Internal switching of terminating resistors permits operation in circuits with load values of 50 or 75 ohms. If measured it will be found that the internal resistors increase in value for a lowered external load and vice-versa. This is essential to maintain a balance between magnetic and electrostatic components.

On many occasions I have heard conversations between Amateur station operators employing half wave doublet radiators fed by open wire balanced

resonant lines coupled to the transmitter by a tuned and balanced coupler. One Amateur operator possesses a s.w.r. meter and the other does not. The second operator seems to be a happy and contented man, working his near and far stations with evident pleasure. Poor old No. 1 operator, owner of the s.w.r. meter, seems to be forever worried over his standing waves and fiddles away at tuning and coupling until his precious instrument finally is coaxed to read as near 1:1 ratio as eyesight can detect. He fondly imagines that the entire radiating system is now operating "standing wave free", as flat as the proverbial pancake, and with no mythical reflected power bouncing back from his radiator. All that he has done is to adjust coupling link and tuning to make the immediate load to the s.w.r. meter look like a resistive load of the instrument selected value of 50 or 75 ohms. From the output terminals onward of the tuned coupler matters have not changed one proverbial iota. The hypothetical standing waves and imagined reflected energy, still, mathematically speaking, bounce forth and back along the transmission line; the latter and its attached doublet behaving like any normal and self respecting resonant dissipative circuit. Happiness now reigns in the household of the owner of the s.w.r. meter for such is the power of suggestion and deep almost reverential faith in the "Hartford Bible".

Another piece of Amateur measuring equipment goes under the peculiar name of Antennascope, although for the life of me I have never been clear as to what this outfit sees. It is a simple form of bridge which indicates in terms of a known variable resistance the degree of balance against the external circuit. No discrimination is made against the respective components of a complex impedance although inability to get a complete null reading on the indicating meter makes it evident that the external load is not a simple dissipative resistance.

To design and construct an efficient radiating system it is essential that the R and jX values of complex loads be known with reasonable accuracy. Commercial r.f. bridges are very expensive items not available at bargain prices through disposal stores. By application of a little elementary mathematics and using small meters and test instruments available in all experimental stations worthy of the name, it is possible to measure with considerable accuracy the resistive and reactive components of lines, radiators and circuits of equipment.

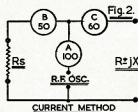
Two forms of measurement are available, the current and voltage methods. For the former, three low range thermomilliammeters are required, and for the latter a v.t.v.m. or low reading microammeter. I have found that for the current method two meters of 125 mA. and one of 250 mA. full scale are

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ideal. In the early twenties and intervening years, I made considerable use of several Weston model 425 thermogalvanometers which are thermo-millammeters with evenly divided 0 to 100 scales. These required a "square scale" to resolve to milliamperes.

THE CURRENT METHOD

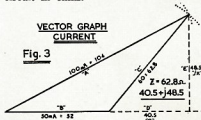
Commencing with the three millimeter meter (see Fig. 2), mount the three meters on a small insulating panel. Tempered Masonite is excellent for experimental panels. Now construct several reference resistors from half or one watt units connected in parallel to give reasonable wattage dissipation. Do not use individual units below 100 ohms in value as these are often wire wound and unsuitable for r.f. work. Most accurate results will be obtained when the reference resistor is of the same order of magnitude as the external circuit impedance or resistance. I have used four paralleled 160 ohm units for 40 ohms, four paralleled 300 ohm units for 75 ohms, five paralleled 1,000 ohm units for 200 ohms, and five paralleled 3,000 ohm units for 600 ohms. Bunch and solder the pigtails of the paralleled resistors and open out the group to form a hollow cylinder. The r.f. resistance will be very close to measured d.c. value.



Use short interconnecting leads to avoid introduction of undesirable inductance, and for the power source a small variable oscillator of several watts rating. Some form of variable control of output is very desirable. In an experimental oscillator at VK2JR, I have used interchangeable plug-in coils for the tuning inductors with an old "honeycomb" coil plug and socket supporting a basketweave coil of several turns for fine control. For easier and remote control of power output I have used construction of an improved wide range oscillator incorporating crystal locking for accurate frequency generation within Amateur bands plus a high tension power supply unit employing a small "vari-volt" auto transformer. The latter permits primary supply to the h.t. transformer to be varied from zero to maximum with resultant following r.f. power. This eliminates the need for a mechanical variation of coupling to the variable oscillator. Construction details will be given in a future article to be published in "A.R."

Select a reference resistor of a value approximating the load value of the external circuit, and adjust the output of the r.f. oscillator to produce approximate mid-scale readings on the "B" and "C" meters. Meter "A" will read the approximate sum of these two cur-

rents. Make careful note of the three readings, whose values form the basis to construct a triangle with sides of relative lengths, as in Fig. 3. Final solution is made easier if the length of side "C" is made in measuring units equivalent to the impedance of that circuit in ohms.



Assume the following meter readings for meters "A", "B", and "C". "A" = 100 mA., "B" = 50 mA., and "C" = 60 mA. As currents in the "B" and "C" arms are inversely proportional to impedance, and if the reference resistor has a value of 75 ohms, the impedance of path "C" must be 75 multiplied by 50/60, or 0.833 times 75 = 62.8 ohms. This figure is 1.04 times the current figure, therefore multiply meter readings "A", "B", and "C" by this figure to produce relative figures of "A" = 104, "B" = 52, and "C" = 62.8. Lay off line "B" 52 units long. Millimetres are a convenient unit within the opening capabilities of simple pencil or drawing instrument compasses. Tenth inch scale graph paper on large sheets will permit construction of a man-sized triangle, reducing greatly any error in final measurements.

From the left end of line "B" draw an arc with radius of 104 units and from the right end of line "B" another arc with radius 62.8 units. At the intersection of these two arcs drop a vertical line to the projection of line "B" to form a new triangle with side C-D-E. Carefully measure the lengths of sides D and E. The length of D will correspond to the value of the "R" component of the complex load, while side E length will be that of the "jX" or reactive component. Only one doubt remains and that is the phase sign of the reactive component to determine whether it is positive or negative. This may be resolved in a very simple manner by slightly increasing the test frequency either by circuit tuning of the oscillator or introduction of a crystal lock on a higher frequency crystal within the Amateur band. If the current in arm "C" increases relative to "B", the former must be negatively reactive, and vice-versa. For Fig. 3, $Z = 62.8\Omega = R \pm jX = 40.5 + j48.5$.

Should meter readings "A" = "B" + "C" the triangle will disappear, indicating that the external circuit does not possess reactance and is a pure resistance. By application of some fairly simple high school trigonometry, it is possible to solve the triangles and determine the phase angle and relative magnitudes of R and jX without need to draw a triangle. As the majority of Amateur station operators unfortunately panic at the sight of even simple mathematical calculations I shall not give the solution in this article, but will do

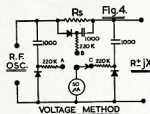
so in a later one describing the construction of measuring equipment.

Leonardo-da-Vinci gave some very good advice many years ago: "He who spurns the great certainty of mathematics fills his mind with confusion, and will never be able to silence the sophistical teachings that lead only to a battle of words". That this is so is evident by the s.w.r. and reflected power "gobblydegook" heard during many Amateur station QSOs.

THE VOLTAGE METHOD

Thermo-millammeters are delicate instruments capable of being destroyed by accidental overloading, and in addition are not very common items of equipment in Amateur stations. The voltage method of measurement should prove most popular as the only indicating instrument required is a low range v.t.v.m. or microammeter.

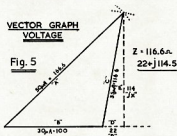
Circuit connections for the voltage method are given in Fig. 4. Three matching diodes are easily obtained and may be wired together with other items in so compact an arrangement as to permit measurement to be made at very high frequencies with negligible error. A batch of reference resistors should be assembled so that one commensurate with the order of magnitude of the external load impedance may be selected. It is not necessary to know the actual value of r.f. voltage measured. Relative values only need be known, and if a microammeter is used as an indicator, microampere readings in positions "A", "B", and "C" will suffice. Knowing the relative voltages across the Reference Resistor "Rs" (meter reading "B") and the external circuit (meter reading "C") the impedance of the latter will be directly proportional to these voltages in contra-distinction to the inverse procedure used with the current method.



Assume that the reference resistor has a value of 100 ohms, and the relative readings of the microammeter are "A" = 50 uA., "B" = 30 uA., and "C" = 35 uA. If "Rs" = 100 ohms, the impedance of the external circuit "C" will be 100 multiplied by 35/30, or 116.6 ohms. The multiplication factor between microamperes and ohms is therefore 3.333. Multiply meter readings "A", "B", and "C" by this factor to become "A" = 166.6, "B" = 100, and "C" = 116.6.

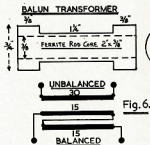
With pencil compass complete a triangle A, B, C as in Fig. 5, with sides 166.6, 100 and 116.6 units long. Draw the triangle on graph paper if available. Any convenient unit scale within the extension capability of the pencil compass will do. Drop a vertical line from the intersection point of arcs "A" and "C" to an extension of line "B"

and measure the respective lengths of sides "D" and "E" of the new triangle so formed. These will be found to be 22 and 114 units respectively, therefore the value of the complex impedance $Z = 116.6 \text{ ohms} + j114.5 \text{ ohms}$. The plus or minus ambiguity of the "j114.5" ohms is resolved by slightly increasing the testing frequency. If the voltage across "C" increases with frequency relative to "B", the external circuit must be positively reactive and vice-versa. A complete mathematical solution without resort to drawing a triangle is possible. A future article will cover this fully.



The circuit arrangement described and illustrated is suited for work associated with unbalanced circuits in which one leg is at earth potential. Balanced circuits are best coupled through a small balun transformer of 1:1 ratio. A toroid construction is not essential.

Fig. 6 illustrates a simple construction for a 1:1 ratio balun capable of operating between 3 to 30 Mc. The former is turned from close grained wood or "Misco" transformer insulating bushing material, the latter being $\frac{3}{8}$ " external diameter with $\frac{1}{8}$ " hole to take a 2" length of $\frac{1}{8}$ " ferrite rod, grade Q1 or Q2 or 4B, which are the respective code designations for Ducon or Mullard ferrites.



For the balanced winding, wind two parallel strands, each of 15 turns of No. 22 s.w.g. d.c.c. copper wire cross connecting the end of winding "A" to the beginning of winding "B" to form a bifilar 30 turn winding. Cover this with several layers of insulating tape and wind a further winding of 30 turns continuous of similar gauge wire. This gives a 30 to 30 turn ratio with high degree of magnetic coupling and balanced electrostatic coupling between the balanced and unbalanced windings. Cut or file small grooves into the end cheeks of the former to allow the windings to bed down to their respective

levels without fouling end turns. Terminals at the ends may consist of $\frac{1}{8}$ " brass screws, or pieces of No. 16 gauge tinned copper driven into $1/16$ " holes. Slightly flatten the ends of the short lengths of No. 16 gauge terminal wire to bite into the $1/16$ " holes. Short flexible leads should connect to the measuring panel. All measured values are what are known as "series" components.

Do not be afraid to perform a little practical measurement work. In one of my lectures to the N.S.W. Division of W.I.A. I showed a slide containing two very important pieces of advice. The first is credited to an Arabic scientist born in A.D.721. No date is available as to the date of his death. Probably he was murdered by one of the prototype Christian Crusaders who played havoc in the so-called Holy Land at around that time and hated scientific enquiry with religious zeal. The name of this Arabic scientist was Jabir ibn Hayyan, and he said: "The first essential is that you perform practical work and conduct experiments, for he who performs not practical work nor makes experiments will never attain the least degree of mastery".

Lord Kelvin, another very wise scientist, once said: "When you can measure what you are speaking about and express it in numbers you know something about it, and when you cannot measure it, when you cannot express it in numbers your knowledge is of a meagre and unsatisfactory kind. It may be the beginning of knowledge, but you have scarcely in your thought advanced to the stage of a science".

Get moving brother experimenters, make some factual measurements around your station. Leave your s.w.r. meters and reflectometers in the cupboard and do not be content to spend the rest of your life as a technical Lazarus living on the crumbs which fall from the disposal store table.

POSTSCRIPT

Taking Lord Kelvin's injunction to heart, I decided that it would be of interest to express the speed of electron current flow in figures. What is generally assumed to be an actual flow of electrons is in reality a vibration travelling in the conducting medium somewhat similar to the shock wave through a string of marbles or ball bearings in long line when, if struck at one end by an incoming marble or bearing releases a corresponding unit at the far end of the line, with inappreciable bulk movement of the system.

A check through Physics and modern Chemistry books gave some very interesting information. One ampere current flow is equivalent to 6.25 times 10^{18} to the eighteenth power ($6.25 \times 1,000,000,000,000,000,000$) electrons per second. The number of electrons in one gramme of copper is 1.74 times 10^{23} to the twenty-third power ($1.74 \times 10,000,000,000,000,000,000,000$).

If a piece of copper of one gramme weight (No. 16 s.w.g. with length = 5.42 centimetres) has its electrons moved at the rate of one ampere it would

take 2,770,000 seconds to completely move through this distance of 5.42 centimetres, or 0.0876 year.

For a conductor 10 metres long, corresponding to about one quarter of a wavelength at 7 Mc., the time for travel would be 16.15 years with other 16.15, or a total of 32.3 years for a reflected wave of really travelling electrons to bounce back from the distant end of the circuit!!!!

The above describes a direct current flow of electrons. With alternating current, the to and fro electron vibration even at the power frequency of 50 cycles is of truly molecular dimensions as a little simple calculation will show.

In an interesting technical book, "Physics for the Enquiring Mind," by Eric M. Rogers, of Princeton University, there appears on page 187 the statement: "In modern atom models we often picture the behaviour of electrons and nuclear particles in terms of standing waves. These are not in themselves proper waves, but they are wavy patterns of vibration that do not travel along."

TRANSISTOR S.B.-C.W.

(Continued from Page 7)

arrange the coil of the antenna relay in the h.t. feed to the linear amplifier so that whenever the linear's plate current rises a little above idling level, the antenna relay is pulled to the transmit position. Parallel resistance and capacity can be used across the relay coil to set the desired time delay. Alternatively, a separate set of contacts a keying relay could be used to activate the vox relay (and through it the aerial relay) simultaneously with the unbalancing of the modulator.

The purists claim that the s.s.b. carrier should, for c.w., be moved to the centre of the filter passband, and that the antenna relay should be closed in the transmit position, before the transmitter supplies power. Certainly, if changing from receiving s.s.b. to c.w., the receiving station will have to return to obtain a c.w. beat note, but this seems to be an automatic reflex action anyway. So far as the antenna relay is concerned, no sign of contact trouble is evident at VK1AU after more than 10 years' operation in which the antenna changed over after the vox relay was tripped and the linear energised.

If there is a real desire to transmit c.w. in the centre of the receiver passband without using the v.f.o. main tuning, I suggest the cheapest method is to use a voltage variable capacitor across the transmitter v.f.o. tank circuit. Adjustment of the voltage control potentiometer will then smoothly shift the v.f.o. as far as is needed. Because full rotation of the potentiometer represents only about 3 kilocycles change of frequency, it is possible to easily QSY a few tens of cycles, often making the difference between a ruined or lost contact, and a completed c.w. contact. The circuit in use at VK1AU is shown in Fig. 2. If enough voltage range is provided, the same control will also act as a calibration reset facility.

REMEMBRANCE DAY CONTEST, 1968

A perpetual trophy is awarded annually for competition between Divisions. It is inscribed with the names of those who made the supreme sacrifice, and so perpetuates their memory throughout Amateur Radio in Australia.

The name of the winning Division each year is also inscribed on the trophy, and in addition, the winning Division will receive a suitably inscribed Certificate.

Objects

Amateurs in each Call Area will endeavour to contact Amateurs in other Call Areas. In addition, Amateurs will endeavour to contact any other Amateurs on the authorised bands above 52 Mc. (i.e. intrastate contacts will be permitted on the v.h.f./u.h.f. bands) for public purposes.

Contest Date

0800 hrs. GMT Saturday, 17th August, 1968, to 0759 hrs. GMT Sunday, 18th August, 1968.

All Amateur Stations are requested to observe 15 minutes' silence before the commencement of the contest on the Saturday afternoon. An appropriate broadcast will be relayed from all Divisional Stations during this period.

RULES

1. There shall be four sections to the Contest:—

- (a) Transmitting Phone.
- (b) Transmitting C.w.
- (c) Transmitting Open.
- (d) Receiving Open.

2. All Australian Amateurs may enter the Contest whether their stations are fixed, portable or mobile. Members and non-members will be eligible for awards.

3. All authorised Amateur bands may be used and cross-mode operation is permitted. Cross-band operation is not permitted.

4. Amateurs may operate on both Phone and C.w. during the Contest, i.e., Phone to Phone or C.w. to C.w. or Phone to C.w. However only one entry may be submitted for sections (a) to (c) in 1.

An open log will be one in which points are claimed for both phone and

c.w. transmissions. Refer to Rule 11 concerning Log entries.

5. For Scoring, only one contact per station per band is allowed. However, a second scoring contact can be made on the same band using the alternate mode. Arranged schedules for contacts on the other bands are prohibited.

6. Multi-operator stations are not permitted. Although log keepers are permitted, only the licensed operator is allowed to make contact under his own call sign. Should two or more wish to operate any particular station, each will be considered a contestant and must submit a separate log under his

membrane Day from VK4BBB log VK4BAA."

C.w.: Substitute operators will call "CQ RD de" followed by the group call sign comprising the call of the station they are operating, an oblique stroke and their own call, eg., "CQ RD de VK4BBB/VK4BAA."

Contestants receiving signals from a substitute operator will qualify for points by recording the call sign of the substitute operator only.

7. Entrants must operate within the terms of their licences.

8. Cyphers—Before points may be claimed for a contact, serial numbers must be exchanged and acknowledged. The serial number of five or six figures will be made up of the RS (telephony) or RST (c.w.) reports plus three figures, that will increase in value by one for each successive contact.

If any contestant reaches 999 he will start again with 001.

9. Entries must be set out as shown in the example, using ONLY ONE SIDE of the paper and wherever possible standard W.I.A. Log Sheets should be used. Entries must be clearly marked "Remembrance Day Contest 1968" and must be postmarked not later than 9th September, 1968. Address them to "Federal Contest Manager, W.I.A., G.P.O. Box N1002, Perth, 6001, West. Aust." Later entries will be disqualified.

10. Scoring will be based on the table shown.

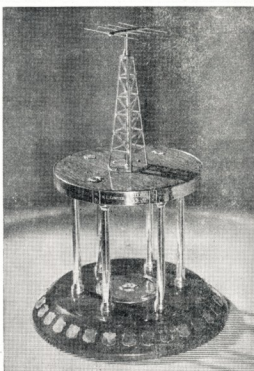
SCORING TABLE

		To									
		VK0	VK1-2	VK3	VK4	VK5-8	VK6	VK7	VK9		
From	VK0	—	6	6	6	6	6	6	6		
	VK1-2	6	—	1	2	3	5	4	6		
	VK3	6	1	—	3	2	5	4	6		
	VK4	6	1	2	—	3	6	5	4		
	VK5-8	6	2	1	3	—	5	4	6		
	VK6	6	1	2	4	3	—	5	6		
	VK7	6	2	1	4	3	5	—	6		
	VK9	6	1	2	3	4	5	6	—		

Note.—Read table from left to right for points for the various call areas.

In addition, all intrastate contacts on bands 52 Mc. and above are worth 1 point each.

Portable Operation: Log scores of operators working outside their own Call Area will be credited to that Call Area in which operation takes place, e.g. VK52P/2. His score counts towards N.S.W. total points score.



Remembrance Day Contest Trophy

own call sign. Such contestants shall be referred to as "substitute operators" for the purposes of these Rules and their operating procedure must be as follows:—

Phone: Substitute operators will call "CQ RD" or "CQ Remembrance Day" followed by call of the station they are operating, then the word "log" followed by their own call sign, e.g., "CQ Re-

EXAMPLE OF TRANSMITTING LOG

Date/Time G.M.T.	Band	Emission and Power	Call Sign Worked	RST No. Sent	RST No. Received	Points Claim.
Aug. '68						
17 0810	7 Mc.	A3 (a)	VK5PS	59002	—	2
17 0812		"	VK6RU	59007	—	5
17 1335	52 "	A3	VK4ZAZ	59019	—	3
17 1040	"	"	VK3ALZ	59025	—	1

Note.—Standard W.I.A. Log Sheets may be used to follow above form.

EXAMPLE OF RECEIVING LOG (VICTORIAN S.W.L.)

Date/Time G.M.T.	Band	Emission	Call Sign Heard	RST No. Sent	RST No. Received	Station Called	Points Claim.
Aug. '68							
17 0810	7 Mc.	A3 (a)	VK5PS	59002	—	VK6RU	2
17 0812		"	VK6RU	59007	—	VK7EJ	5
17 1335	52 "	A3	VK4ZAZ	59019	—	VK5ZDR	3
17 1040	"	"	VK3ALZ	59025	—	VK3QV	1

Note.—Standard W.I.A. Log Sheets may be used to follow the above form.

11. All logs shall be set as in the example shown and in addition will carry a front sheet showing the following information:—
 Name..... Section.....
 Address..... Call Sign.....
 Claimed Score.....
 No. of Contacts.....

Declaration: I hereby certify that I have operated in accordance with the Rules and spirit of the Contest.

Signed.....
 Date.....

All contacts made during the Contest must be shown in the log submitted (see Rule 4). If an invalid contact is made it must be shown but no score claimed.

Entrants in the Open Sections must show c.w. and phone contacts in numerical sequence.

12. The Federal Contest Manager has the right to disqualify any entrant who, during the Contest, has not observed the regulations or who has consistently departed from the accepted code of operating ethics. The Federal Contest Manager also has the right to disallow any illegible, incomplete or incorrectly set-out logs.

13. The ruling of the Federal Contest Manager of the W.I.A. is final and no disputes will be discussed.

Awards

Certificates will be awarded to the top scoring stations in Sections (a) to

(c) of Rule 1 above, in each Call Area. There will be no outright winner for Australia. Further Certificates may be awarded at the discretion of the Federal Contest Manager.

The Division to which the Trophy will be awarded shall be determined in the following way.

To the average of the top six logs shall be added a bonus arrived at by adding to this average the ratio of logs entered to the number of State Licensees (including Limited Licensees), multiplied by the total points from all entries in Sections (a), (b) and (c) of Rule 1.

$$\text{Average of top six logs} + \left\{ \begin{array}{l} \text{Logs Entered} \\ \text{State Licensees} \end{array} \times \begin{array}{l} \text{Total Pts. from} \\ \text{all Entrants in} \\ \text{Sect. (a) (b) (c)} \end{array} \right\}$$

includ. Z Calls

VK1 scores will not be included with VK2, nor VK8 with VK5.

Acceptable logs for all Sections shall show at least five valid contacts.

The trophy shall be forwarded to the winning Division in its container and will be held by that Division for the specified period.

**RECEIVING SECTION
 (Section D)**

1. This section is open to all Short Wave Listeners in Australia, but no active transmitting station may enter.
2. Contest times and loggings of stations on each band are as for transmitting.

3. All logs shall be set out as shown in the example. The scoring table to be used is the same as that used for transmitting entrants and points must be claimed on the basis of the State in which the receiving station is located. A sample is given to clarify the position.

It is not sufficient to log a station calling CQ—the number he passes in a contact must be logged.

It is not permissible to log a station in the same call area as the receiving station on the m.f. and h.f. bands 1.8–30 Mcs., but on bands 52 Mcs. and above such stations may be logged, once only per band, for one point. See example given. VK1/VK2 and VK5/VK8 are considered to be the same area for scoring purposes.

4. A station heard may be logged once on phone and once on c.w. for each band.

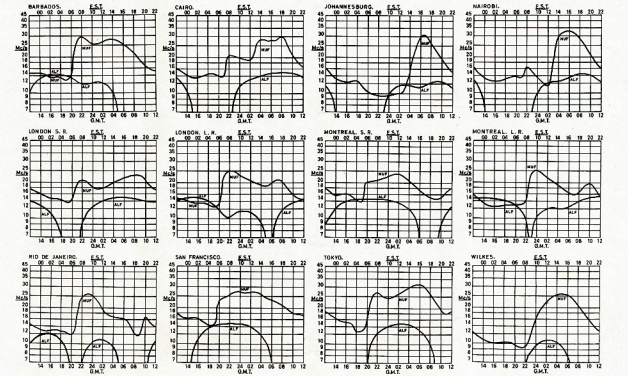
5. Club receiving stations may enter for the Receiving Section of the Contest, but will not be eligible for the single operator award. However, if sufficient entries are received a special award may be given to the top receiving station in Australia. All operators must sign the Declaration.

Awards

Certificates will be awarded to the highest scorers in each call area. Further Certificates may be awarded at the discretion of the Federal Contest Manager.

PREDICTION CHARTS FOR JULY 1968

(Prediction Charts by courtesy of Ionospheric Prediction Service)



VK3 V.h.f. Group 6 Metre Converter—Untuned Output

G. S. BYASS,* VK3ZWA

Book Review

RADIO AMATEUR'S HANDBOOK 1968 Edition

The A.R.R.L. Handbook has been the standard reference manual for Amateurs since its first publication in 1926, since when over four million copies have been sold.

This 45th edition is once again an improvement on its predecessors. The use of non-gloss paper and very clear and sharp photographs and drawings make this edition very easy to read. Also, at last, much more emphasis has been placed on solid state devices, bipolar transistors, field effect transistors, integrated circuits, zener and variable capacitance diodes, and SCRs.

Many of the construction projects appearing in earlier editions have been replaced by new material. Also, information has been included in the construction practices section on how to fabricate etched-circuit boards, build transistor heat sinks, and assemble SCR-operated motor-speed controls.

Other changes include new v.h.f. and u.h.f. antennas and stacking methods, solid state portable and mobile equipment, new transistor data tables and revised vacuum valve tables and charts. If you have not bought a copy of the A.R.R.L. Handbook for a few years, this is the issue to buy to bring you up-to-date.

Published by The American Radio Relay League, Australian price \$5.45. Review copy from Technical Book and Magazine Company Pty. Ltd., 289-299 Swanston St., Melbourne.

WORLD RADIO T.V. HANDBOOK, '68

Since its inception more than two decades ago, this handbook has been a favourite with all international radio listeners. During this time it has amazingly been able to extend, improve, correct and bring completely up-to-date its valuable contents of information. It not only provides a quick and easy reference to all radio and t.v. stations in the world, but also contains practical suggestions and examples to help S.W.I. DXers to enjoy their hobby to the full. All in all, a must for all serious short-wave listeners.

Australian price \$5.40 plus 25 cents postage. Review copy from Technical Book and Magazine Company Pty. Ltd., 289-299 Swanston St., Melbourne.

HOW TO BUILD A TRANSISTORISED AMPLIFIER

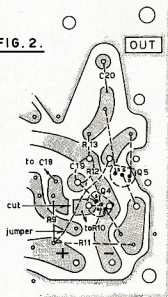
Although designed for the newcomer to radio construction, this booklet could also be an interesting one for the valve man who has finally decided to get his feet wet in the field of transistors. Based on a three-transistor circuit from Mini-watt Digest Vol. 3 No. 3, the text and drawings are excellent, and the booklet contains a metallised cardboard circuit board.

Price 75 cents. Review copy from A. H. and A. W. Reed Pty. Ltd., 51 Whiting St., Artarmon, N.S.W.

The sketch, Fig. 2, shows the bottom of the board with the added components on the top of the board shown with dotted lines. R12 and R13 have to be mounted vertically as there is insufficient room to mount them flat on the board.

NOTE: — ONLY ADDITIONAL COMPONENTS SHOWN. DOTTED LINE SIGNIFIES COMPONENTS ON TOP OF BOARD

FIG. 2.



UNDERNEATH VIEW OF P.C. BOARD

CALL BOOK, 1968-69 EDITION IMPORTANT NOTICE TO RADIO CLUBS

Are the details of your Club, as listed on page 58 of the 1967-68 edition, still applicable? If not, make sure your Secretary writes to us without delay.

If your Club was not listed and you feel it should be, send the details now.

We go to press mid July.

ERRATA

Below are listed two corrections to an article entitled "A Crystal Locked AM-CW Transmitter for 6 Metres" that appeared in the June issue.

(1) The resistor shown as connected to the centre contact of S1A should be 15K ohms not 15 ohms.

(2) The neon on the p.a. output is shown incorrectly wired, it should be as illustrated below.



The VK3 V.h.f. Group 6 Metre Converter was designed with a tuned output stage employing a pi network and for the majority of applications this system offers a number of advantages. However, there are applications where an untuned output is desirable (e.g. when using a low i.f. frequency or when it is desired to change the i.f. to suit different receivers), and with this in mind one of the prototype converters was modified as shown in Fig. 1.

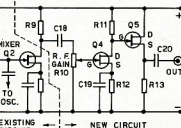


FIG. 1 MODIFIED OUTPUT CIRCUIT

R9—15K ½ watt.
R10—100K ½ watt.
R11—10K ½ watt.
R12—5.6K ½ watt.
R13—500 ohm ½ watt.

C18—1000 pF. ceramic.
C19—5000 pF. ceramic.
C20—3000 pF. ceramic.
Q4—2N3819 FET.
Q5—2N3819 FET.

DESCRIPTION

The circuitry is relatively simple, consisting of a resistive load in the mixer followed by a common source FET amplifier and a FET source follower to provide a low output impedance. The r.f. gain control and the extra stage of gain was provided because the tuneable i.f. was to be a car radio with a rather doubtful performance. If the tuneable i.f. receiver has adequate sensitivity it should be possible to eliminate the extra amplifier stage and merely couple the source follower direct to the mixer. Similarly, the r.f. gain control could be dispensed with and replaced by a fixed resistor or a pre-set control as required.

CONSTRUCTION

All the components with the exception of the r.f. gain control can be mounted on the existing board with only one copper land having to be modified. This is shown on the accompanying sketch of the board and component layout, Fig. 2.

Components L4, C8, C10, C11 and R5 should be removed from the board and the copper land cut as shown with a sharp knife and the small strip of copper peeled away from the board. The components R11, R12, R13 and C19 are mounted on the top of the board as are the two FETs Q4 and Q5.

R9 and C20 are mounted on the underneath (copper) side of the board with C18 and R10 placed where convenient, taking care to keep the leads as short as possible.

* Flat 16, 137A Woodland Street, North Essendon, Vic., 3041.

Correspondence

Any opinion expressed under this heading is the individual opinion of the writer and does not necessarily coincide with that of the Publishers.

MRSA CARPHONE ON A.C.

Editor "A.R." Dear Sir,
I referred to your article about three months ago enabling the MRSA Carphone to be used on a.c. by applying 12v. a.c. to the primary of the transformer and connecting the vibrator and putting a shorting plug in its place, etc., etc.

I tried this out and felt the following experiences should be made known to would-be modifiers.

(a) The vibrator transformer runs too hot for my liking. No transformer should be subjected to this heat for too long. After 20 minutes or so it was as hot as a finger could stand when held against the laminations.

(b) Reports of drifting of frequency after transformer heats up. Quite obviously the power transformer's heat radiation is heating the 1x1x1x1 after which the about 1/2 inch from the transformer) and causing frequency shift.

Either the xtal would have to be moved away from the transformer to a cooler section of the set or heat absorbent shielding would have to be placed around it. I have not tried this as I don't like the heating effect on the transformer and will supply the required voltages another way from an external source which would not produce heat.

So in my book this modification is definitely not good enough.

—H. S. Michael, VK3ASI.

The original article attracted a warning on the subject of increased fire insurance (by restricting the input voltage). The method outlined to operate the MRSA from a.c. is useful when making adjustments or repairs to the equipment.—Ed.

ROSS HULL CONTEST RESULTS 1968

Editor "A.R." Dear Sir,
In the rules of the above Contest published in your issue of 1967, three sections were described: (1) Transmitting Open, (2) Transmitting Closed, (3) Receiving Open. As I entered the last two, I was in the results published in May "A.R." no result was shown for my Open section entry.

This has been discussed with the Federal Executive and they now invite comments from others through your columns on this matter.

It appears that to be eligible to participate in the Open section of the Contest an operator must have a c.w. contact. What is so special about c.w.? Why select this mode of emission as being the difference between the Open and Phone sections? Why not select r.t.t.y.?

As I see it, the "Open" section should be open to ALL modes. If I choose not to use c.w. then my hand, my opportunity, my time, to make certain contacts, but this is my choice.

By all means have a c.w. section in the Contest. Please let an open section be really "open".

—W. J. Howse, VK6ZAA.

P.S.—The modes used by me in the Contest were A3, A3s, F3.

"A.R." MAGAZINE

Editor "A.R." Dear Sir,
I wish to write in support of VK3AMK's letter in June issue. I read with dismay in "A.R." that the Zonta notes were to be deleted due to lack of funds to continue a magazine of the present size.

I don't read every page of "A.R." as some information is of no particular interest to me, but it is of importance to others. In my opinion we would do well to consider "A.R." as a magazine of the future, even though it would cost more. As Geoff has commented, we are prepared to spend \$700 a year to trade this magazine for W.L.A. dues too high at \$6 or thereabouts. Some other organisations we belong to have membership fees much higher than \$6, so it should be a goal. To keep our Amateur Radio politically as it is, money is an important item. With extra dues a more effectively financed ITU representation would be possible and our method of communications to the Amateur population in general through Amateur Radio assured.

As Max VK3ZS has also commented, we cannot continue to increase dues and so we must increase membership. I agree with his remarks and perhaps our complacency regarding Amateur Radio's future is why our

membership numbers have not increased and why we are not keen to increase our dues. In general, the average Amateur is not aware how much time and effort has gone into Amateur Radio politics via the W.L.A. and the unpaid staffing.

Okay chaps, what about us all doing a bit more for our organisation, the W.L.A. It won't cost us anything. We can do it in whatever way you can do service, the many officers in your Division are always after keen chaps; Federal officers, editorial staffing, notes and articles, "A.R." There is sure to be some way you can help.

Finally, please allocate more money to "A.R." even if it costs \$100. A.R. is too valuable to have its standard lowered.

—Rodney Champness, VK3UG.

Editor "A.R." Dear Sir,
A few years ago I passed a remark to a VKS Federal Councillor (I'll wager you recall the remark, Phil) to the effect that "Amateur Radio" is a fairly loose magazine.

A very small amount of self analysis has led me to believe that I am a fairly loose Amateur, because I have done nothing to contribute to the improvement of the magazine. Now we find that through lack of support we are about to get even less in the way of material to produce the magazine. Is it then the VKS Amateur? A great number rave over the wonders of "QST", "CQ", "73", "R.S.G.B. Electronics Australia", to name a few (have you contacted them?). \$25.00, \$20.00, \$15.00, \$10.00, \$5.00, \$3.00 per annum for the respective. Many purchases all the year round, \$25.00 per year.

Let's be original! Many VKs have a reasonably high I.Q.—their articles are well worthy of the magazine. I am sure you can find opportunity? A wise old man once said, "You can have everything in this world that you wish to have, provided that you are prepared to pay the price."

So I ask you, chaps! How about throwing in \$10 per year to enable those stalwarts to produce material which you may be justly proud? We, too, can also be proud of being part of it. Let's Do IT NOW.

—Bill Crawford, VK5XB.

(Similar letters have been received from VK2ZGW, VK3UG, VK3ZCG, L2023 and L3102. Space does not permit me to include them, but they will be incorporated into the report being prepared for Federal Council.—Ed.)

S.W.L. and VK/ZL/OCEANIA DX CONTEST

Editor "A.R." Dear Sir,
On page 15 of the April 1968 issue of "A.R." appeared the results of the 1967 VK/ZL/Oceania DX Contest (Phone, C.W.).

After reading the results, my mind stirred and my heart beat (literally) at noting that only a paltry one per cent. of W.L.A. S.W.L. members saw fit to submit an entry.

I find it hard to believe that only 19 of approx. 1,000 "could-be starters" showed sufficient interest in the 1967 Contest to submit an entry to the Federal Contest Manager, but the proof is there all right.

It puzzles me to no end in trying to think out why so many persons who profess to have interest in our hobby, to submit an entry, or even take part in the event. Surely an hour or two could be spent by 100 S.W.L.'s once a year in taking part in the contest, and saving annual event—even if you don't know your c.w., what's wrong with logging radio telephone signals for a short period and then spending half an hour or so writing up contest entry log. Should be no effort at all for most if not all S.W.L.'s.

As a contest entrant (Amateur Radio type) for nearly 40 years (and veteran of over 100 contests) I write from experience when I say that an S.W.L. gains much, and loses nothing (except time) by taking part in contests such as the VK/ZL/Oceania DX Contest.

I appeal to the various State S.W.L. Groups, as well as individual S.W.L.'s throughout Australia, to consider entering the 1968 event and submit a log by the entry closing date. Even if only two or three hours can be devoted to contest activity, but this time the contest would be thrilled to get your entry. It's not so much the winning of such an event, as entering it, which satisfies most. Prove this by being a contestant yourself, and you won't regret it. You will be a much more competent S.W.L. operator and your know-how of our hobby will be increased immensely. It will certainly go much of the way to making you a better operator for the days when you become a transmitting operator type.

Finally, let us see 100 S.W.L. entries from VK in the 1968 VK/ZL/Oceania DX Contest results.

—Eric Trebilcock, L3042.

EXPRESSION OF THANKS FROM THE FEDERAL PRESIDENT, W.I.A.

Dear Fellow Amateurs,

During Easter 1968 I presided as Chairman of the 32nd Annual Federal Convention of the Wireless Institute of Australia (W.I.A.) and as such it brought to a close my 18 years of service on the Federal Executive of the Institute.

On the occasion of the official dinner on the Saturday evening I was presented with a most handsome stainless steel drink tray and ice-cube tray—very nicely engraved—together with a cheque for the purpose of obtaining a suitable piece of Amateur equipment for my personal use.

These were presented as a mark of appreciation for my long devotion to the requirements of the Amateur Service by the Federal Executive, Federal Council and the Amateurs of Australia.

I cannot express in suitable words the real thrill it gave me to realise that my humble efforts had been deserving of such a wonderful thought by those with whom and for whom I had worked for the love of Amateur Radio. I thank all those who have been my great pleasure to have been associated with the Institute Administration during almost two decades of tremendous growth, and I am bound to express my appreciation to you—past and present—throughout the Institute without whose assistance such growth would not have been possible.

I therefore take this opportunity—through the pages of "Amateur Radio" magazine—to say thank you for your appreciation extended to me by means of this presentation. It came as a complete, but pleasurable surprise to know I had so many friends who had thought fit to express their feelings in this way. It will be an event which will always remain with me as being one of the only times I have ever been "rich" for words and an event which I shall always cherish in my memory upon the inevitable day when I join the ranks of silent keys.

Might also take this opportunity of extending my hearty good wishes for the future prosperity of the Wireless Institute of Australia and the role of representing the Amateur Service in this country. The Institute is indeed entering a new era with the introduction of a Region III, organisation of the International Amateur Radio Union (I.A.R.U.) as a result of the inaugural Regional Congress held in Sydney conjointly with the 32nd Annual Federal Convention.

The next few years will be fraught with many problems and require an immense overall effort by those conducting the affairs of the Institute. Without the support of members such an effort would be in vain. I am hopeful, therefore, that the Amateurs of Australia will become aware of the dangers besetting the Amateur Service world wide, and be prepared to make the small individual sacrifices which they may be called upon to do to preserve for posterity the greatest of all hobbies—Amateur Radio.

I again thank you all for your magnificent presentation.

Yours sincerely,

G. Maxwell Hull, VK3ZS,
(Federal President—Retired)

PROVISIONAL SUNSPOT NUMBERS FOR APRIL 1968

Dependent on Observations at Zurich Observatory and its Stations in Locarno and Arosa.

Day	R	Day	R
1	82	14	81
2	100	15	91
3	108	16	63
4	108	17	83
5	89	18	63
6	85	19	63
7	89	20	64
8	79	21	66
9	74	22	66
10	82	23	68
11	94	24	48
12	104	25	64
13	104	26	64
14	83	27	57
15	60	28	82
16	60	29	71
17	110	30	96

Mean equals 81.6.

Smoothed Mean for October, 1967: 94.0.

Predictions of the Smoothed Monthly Sunspot Numbers:

May 1969	August 1969
June 1969	September 1969
July 1969	October 1969

—Swiss Federal Observatory, Zurich.

SSB EQUIPMENT

Yaesu Type "F" Generator Boards, basis for SSB transmitter. Not a kit, but a completely wired and tested crystal filter SSB assembly. Includes mic. amp., B.M., carrier osc., I.F. amp., valves and circuit. \$39 each plus postage (wt. 2 lbs.).
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Credits for new members and those whose totals have been amended are also shown.

PHONE

VK3MS	317/338	VKSAB	300/314
VK3AHO	314/326	VK4FJ	279/296
VK6RU	307/330	VK3TL	271/275
VK6MK	304/322	VK2APK	254/287
VK2JZ	301/316	VK2AAK	263/287
VK4HR	300/316	VK4TY	256/287

Amendments:

VK3AMK	133/133	VK4PX	162/163
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C.W.

VK3QL	295/315	VK3NC	266/286
VK3AHH	294/306	VK3ARX	268/274
VK3CX	291/312	VK3YL	265/282
VK4FJ	291/313	VK6RU	264/285
VK2AGH	281/294	VK2APK	261/268
VK4HR	273/285	VK3KB	259/272

OPEN

VK3AGH	310/328	VK4TY	295/297
VK6RU	306/325	VK3YL	293/314
VK4HR	307/329	VK3TL	287/291
VK2VN	306/321	VK3ARX	287/295
VK6MK	305/322	VK2APK	284/282
VK4FJ	285/318	VK2ACX	276/300

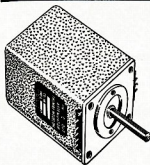
New Member:

VK3ABA 112/115

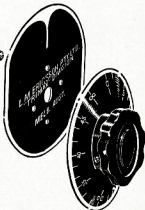
Amendment:

VK4PX 165/166

Note: The call VK4GM was inadvertently shown in the May and June listing. This should have been shown as a cancellation of VK2ADE.



Cover size: 2½" square plus terminal pin projections: Oval diameter: 2½"; Escutcheon: Oval 2½" x 3"; Overall depth behind panel: Single unit 2½", Double Unit 3½"; Mounting: 2 x ½" holes 1½" centre distance with ½" dia. centre hole.



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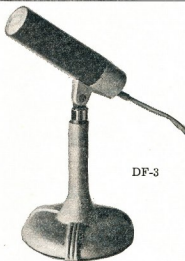
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- NOISE LIMITER
- A.C.-D.C. OPERATION
- INBUILT POWER SUPPLY

SPECIFICATIONS:

RECEIVER
Frequency Range: 144-148 Mc AM
Sensitivity: 1 microvolt for 10dB S/N at 145.5 Mc (0.05 W Audio Output)
Image Ratio: 50 dB at 145.5 Mc
IF Frequency: 1st IF 44-45 Mc
 2nd IF 10.7 Mc
 3rd IF 455 Kc
Noise Limiting: Automatic
Squelch: 1 microV-300 microV
Selectivity: 20 dB down at 10Kc
Audio Output: 3W 8 ohms
Input Impedance: 50 ohms (Unbalanced)
TRANSMITTER
Frequency Range: 144-148 Mc AM
Power Input to Final: 22 to 26 Watts
RF Output Power: 10W 144-146 Mc
 AC 240V Operation
 9W 144-146 Mc
 DC 12.8V Operation
 FT-243
Crystal Type: 8-8.222 Mc
Crystal Frequency: 8-8.222 Mc

VFO Frequency: 8-8.222 Mc
Microphone Input: High Impedance w/Push to Talk
Frequency Response: —3 dB at 300 and 3,000 c/s
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POWER SUPPLY
AC Operation: 117/230V 60/50 c/s
 Receive Power Drain 106 VA
 Transmit Power Drain 146 VA
DC Operation: DC 12.8V (12/14V)
 Receive Power Drain 90 VA
 Transmit Power Drain 120 VA
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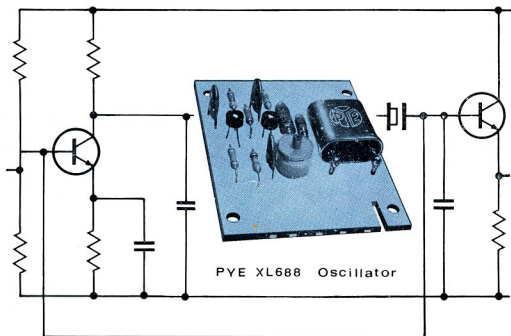
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